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made when the plants were at the end of their vegetative period, while those of Frank were made shortly before their flowering, a fact that might have led to the difference in results.

In *Trifolium* the tubercles are developed all the year round without being dependent upon the growth of the plant. It would appear that the biological process in these tubercles consists in the bacteria becoming transformed into bacteroids by a certain kind of hypertrophy, and that when dead the organisms are resolved into a fatty substance. The author is unable to believe in anything like a reabsorption of the bacteroids. The result of his examinations shows that the tubercles are not to be differentiated, either in their shape or in regard to their contents; thus no dimorphism is observable.—THEO. HOLM.

Report on recent experiments in checking potato disease in the United Kingdom and abroad. London, 1892, pp. 193, figs. 5.

Notwithstanding the fact that the potato is the standard crop, constituting the larger part of the food of the people of Ireland, and is an important product of England and Scotland; that the vegetable is known to have been affected by fungi since 1844; that the disease has in some years been so severe as to cause tremendous losses and even a famine in Ireland; and that for the past six years the disease has been known to be successfully combated by copper compounds, still the authorities of Great Britain do not seem to have made any attempt to prevent the disease by treatment with these compounds until 1891. It is true that when the results of experiments made in France in 1838 became known, the attention of the Government was called to them, but without any result, save the issuance of a report or two. In 1891 the Royal Agricultural Society of England began to make some experiments. The board of agriculture also began to bestir itself and to inquire of foreign consuls what progress had been made in checking the disease. The results of the experiments and inquiries are embodied in the report at present under notice, and which was issued by the board of agriculture in the spring of 1892.

The report is divided into four parts: Part 1, contributed by Charles Whitehead, consists of a history of the disease; its cause; the life history of the fungus; and the action of "bouillie bordelaise," or Bordeaux mixture, as it is commonly called. From this introduction it appears that although in 1846 Berkeley had shown the disease to be caused by a fungus, agriculturists generally up to as late a date as 1872 believed the fungus to be the effect rather than the cause. This is shown by the fact that out of ninety-four essays submitted as the result of an offer of £100 for the best account of the trouble and its remedies, not one was deemed worthy of the prize, and not one contained correct ideas as to its origin. This is certainly remarkable when we remember the number of able botanists which England possesses and the demonstration by Berkeley twenty-five years before. The idea also at one time pre-

vailed that there were disease-proof varieties of the potato, but this was speedily disproved by experiment. In the discussion of the action of Bordeaux mixture the rather remarkable statement is made (p. 22) that "at present there are no clearly defined formulae." It is difficult to understand how anything can be made more definite than the formula given for the Bordeaux mixture in Circular No. 4 of the Section of Vegetable Pathology, U. S. Department of Agriculture, issued in July, 1889. While the formula has since been modified, the directions there given were sufficiently explicit.

The second part deals with the experiments conducted by the Royal Agricultural Society in Great Britain and Ireland in 1891. These experiments were made in various places and under varied conditions, and the results were not in any way uniform. In some no benefit was reported, while in others it was very marked. The general conclusion reached, however, was that when applied at the proper time and in the proper way a decided benefit was derived from the use of Bordeaux mixture.

The third part deals with the experiments for checking the disease and the culture of the potato in foreign countries. Eleven questions were submitted to the representatives of Great Britain in Austria-Hungary, Belgium, Denmark, France, Germany, Netherlands, and the United States. These questions related to the varieties usually grown, changes of seed, methods of seeding, frequency of cropping, manner of cultivation, manures used, occurrence of disease, precautions taken against it, measures to prevent its appearance, remedies adopted, and the results of the treatment. We have here a digest of the experiments made in the countries mentioned, and it is valuable as a compilation of late information. The experiments in France, Belgium, and Holland are especially referred to, and in some cases given in full. Part 4 gives a summary of reports on potato culture in the colonies, mainly those of Australia, where, however, the disease either does not exist or does but little damage. It occurs to a greater or less extent in the Bermudas and on the Cape of Good Hope.—JOSEPH F. JAMES.

SARAUW, G. F. L.—*Rodsymbiose og Mykorrhizer særlig hos Skovtræerne.*
<Bot. Tidsskrift, vol. XVIII, Copenhagen, 1893, pp. 134, pl. 2.

The present paper contains a complete account of the various theories and explanations which have been given of the "root symbiosis and the Mycorrhizæ." It contains abstracts of a large number of papers from the earliest up to the present time, while the original investigations of the author are merely alluded to. It should be pointed out that the present paper represents only the historical part of a comprehensive work entitled "Bögens Svamprödder," for which the author was awarded the prize of the Royal Danish Academy of Sciences.

The various forms of parasitism are discussed as "antibiosis" and "symbiosis," terms which were proposed by Vuillemin (1889), and which